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(54) Abstract Title

Fire / explosion suppression agent mixing and discharge system, liquid mist in inert gas suppressant and method of discharge

(57) A fire / explosion suppressant system comprises a source, such as a pressurised vessel 5, of liquid suppressant, a source of pressurised inert gas, such as a pressure vessel 14, means, such as pressure flow regulator 8, for feeding the suppressant and inert gas to mixing means 6 to produce a mist of the liquid entrained in the pressurised inert gas, and discharge means 26, 28 for discharging the entrained mist and pressurised gas into an area to be protected. Also disclosed is a fire / explosion agent comprising a liquid suppressant mist entrained in an inert gas. Further disclosed is a method of fire / explosion suppression comprising discharging the aforementioned suppression agent from the aforementioned system into an area to be protected. The gas and liquid / mist flows may physical interact by a shearing action to mix as they mutually impinge in the mixing means 6. The liquid suppressant may be a chemical such as a hydrofluorocarbon, bromocarbon or halogen. The inert gas may comprise one or more of argon, nitrogen and carbon dioxide.

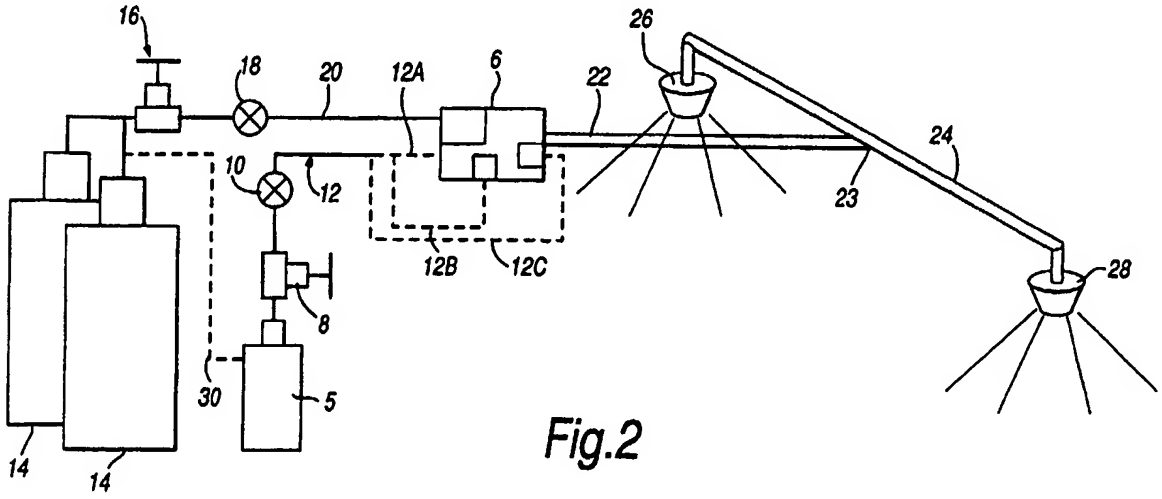

Fig.2

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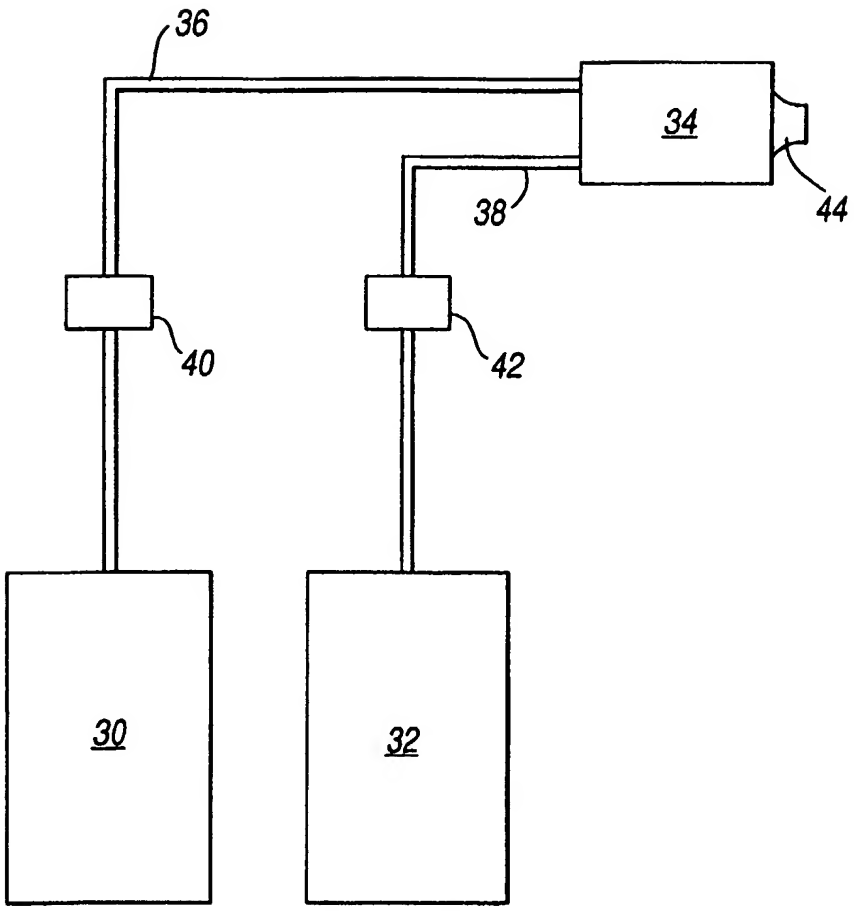

Fig.1

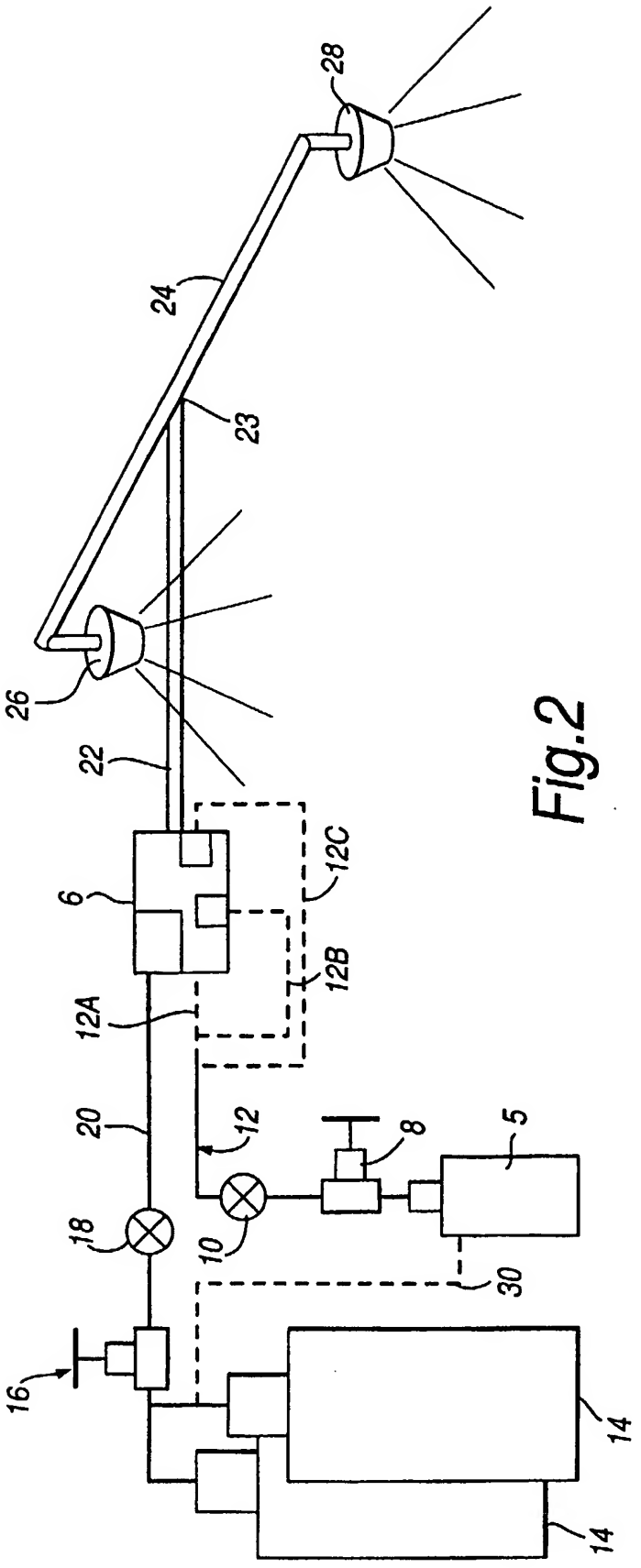

Fig.2

FIRE AND EXPLOSION SUPPRESSION

The invention relates to fire and explosion suppression. Embodiments of the invention, to be described below by way of example only, use liquid suppressants in mist form.

According to the invention, there is provided a fire or explosion suppression agent, comprising a mist formed from a fire or explosion suppressant which is substantially liquid at normal temperatures and pressures entrained in an inert gas.

According to the invention, there is also provided a method of suppressing a fire or explosion, in which a suppressant which is in liquid form or substantially so at normal temperatures and pressures is discharged into an area to be protected in the form of a mist entrained in an inert gas.

According to the invention, there is further provided a fire or explosion suppressant system, comprising a source of a suppressant which is in liquid form or substantially so at normal temperatures and pressures, and a source of pressurised inert gas, means for feeding the suppressant and the gas to mixing means to produce a mist of the liquid entrained in the pressurised gas, and discharge means for discharging the so-entrained mist and the pressurised gas into an area to be protected.

Fire and explosion suppression systems and methods according to the invention,

employing mists, will now be described by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a schematic diagram of one of the systems; and

Figure 2 is a schematic diagram of another of the systems.

The systems to be described employ liquid suppressants. Such liquid suppressants may include water. More particularly, however, they comprise chemical suppressants which are in liquid form, or substantially so, at normal temperatures and pressures. Examples of such chemical suppressants include hydrofluocarbons, bromocarbons and halogenated ethers.

At present, suppressants that are essentially liquid at normal temperatures and pressures can be deployed for extinguishing fires using, for example, appliances such as hand-held fire extinguishers which deploy the suppressants in their normal form. They may be satisfactory in such applications but, because they are deployed in liquid form (e.g. as a liquid stream), they must be more or less directed at the fire for maximum effectiveness. They cannot be deployed in this way as a total flooding agent - that is, such as in gaseous or liquid form from which they will expand to fill a space in which a fire or explosion may exist or in which a fire or explosion is to be prevented. In many applications, such a total flooding capability is important in order to ensure that a specified space or volume

(such as a room or the interior of a vehicle or a volume within an aircraft) can be more or less filled with the suppressant.

The systems and methods to be described are therefore essentially concerned with liquid suppressants, chemical suppressants in particular, which are in liquid form, or substantially so, at normal temperatures and pressures, and enable such suppressants, in spite of their liquid form, to be deployed as total flooding agents.

As shown in Figure 1, the liquid suppressant, such as the hydrofluorocarbon, bromocarbon or halogenated ether, is stored under pressure in a suitable vessel 30. An inert gas, typically nitrogen, is stored under pressure in a second vessel 32. The vessels 30 and 32 are respectively connected to an output unit 34 by pipes 36 and 38 and control valves 40 and 42. When the control valves 40 and 42 are opened, the liquid suppressant and the inert gas are fed under pressure to the output unit 34. The output unit 34 comprises a hollow chamber into which the liquid suppressant and the inert gas are discharged. Within the mixing chamber, the gas and the liquid physically interact and the gas causes the suppressant to be formed into a mist made up of droplets of small size, preferably in the range of between 5 and 60 micrometres. The mist is produced partly by a shearing action of the gas on the liquid suppressant. Within the unit 34, the liquid suppressant may enter in a direction substantially parallel to the direction of the gas. Instead, it can enter substantially at right angles to the gas and the shearing action will be greater. Another possibility is for the liquid suppressant to enter in a direction opposite

to that of the gas, and the shearing action may be greater still. The resultant mist of the liquid suppressant together with the inert gas, which carries the mist, exits through a nozzle 44 into the volume or area to be protected.

The liquid mist, carried by the inert gas, now forms a suppression agent having some of the characteristics of a gaseous suppressant. In particular, because the mist is being carried by the inert gas, it can permeate and expand into all or most parts of the space or volume to be protected and thus provide a total flooding capability.

The output unit 34 may be arranged to supply more than one nozzle 44. More particularly, it may supply a pipework array with multiple nozzles.

Figure 2 shows how such a liquid suppressant may be deployed in mist form and carried by an inert gas using a system of the form disclosed in our co-pending United Kingdom patent application No. 0100530.5 (Serial No.).

In Figure 2, a vessel 5 stores the liquid chemical suppressant under pressure. The vessel 5 is connected to an input of a mixing unit 6 via a pressure regulator 8, a flow regulator 10 and a pipe 12. The dotted lines 12A,12B and 12D show alternative connections of the pipe 12 to the mixing device 6.

The system also includes a vessel 14 storing an inert gas such as nitrogen which has an

outlet connected via a pressure regulator 16, a flow regulator 18 and a pipe 20 to another input of the mixing unit 6. The mixing unit 6 has an outlet pipe 22 which connects with the distribution pipe 24 terminating in spreader or distribution heads 26,28.

In use, the liquid suppressant from the vessel 5 and the inert gas from the vessel 14 are fed under high pressure into the mixing unit 6. Within the mixing chamber of the mixing unit, the inert gas causes the liquid suppressant to be formed into a mist made up of droplets of small size, again preferably in the range of between 5 and 6 micrometres. The mist is produced partly by a shearing action of the gas on the liquid suppressant, and alternative forms of shearing action can be achieved as described above with reference to Figure 1.

The mist carried by the inert gas exits the mixing chamber 6 along the outlet pipe 22 to a T-junction 23 and thence along the distribution pipe 24, and exits from the spreaders 26,28 into the volume to be protected.

In the system of Figure 2, as explained in more detail in the above-mentioned co-pending patent application, it is an important feature that the mixing unit 6 in which the mist is produced is separate from and distanced from the outlets or spreaders 26,28. The mist exiting the mixing unit 6 moves at high velocity and is entrained by and within the high pressure gas. The resultant turbulence in the pipe 22 helps to reduce the size of the droplets in the mist. The high velocity mist exits the spreaders as a two-phase mixture

which consists of the inert gas carrying fine droplets of the liquid chemical extinguishant. The gas continues to expand, on exiting the spreaders 26,28, producing an even mixture - which thus acts again as a total flooding agent.

The presence of the inert gas in the discharged mist increases the efficiency of the extinguishing and suppression action.

The systems described above with reference to Figures 1 and 2 have used nitrogen as the inert gas. Other suitable gases are argon and carbon dioxide or mixtures from any two or more of these gases and nitrogen. However, any other suitable gas or gas mixture may be used which is non-combustible or is effectively inert in a flame.

Besides the hydrofluorocarbon, bromocarbon and halogenated ether liquid suppressants mentioned above, other chemical suppressants may be used which are in liquid form at normal temperatures and pressures or have near-liquid form at such temperatures and pressures - that is, including liquids with low vapour pressures which can thus be discharged more effectively, to act as total flooding agents, when carried by the inert gas.

Many liquid chemical fire extinguishants have the advantage of being clean agents in that they leave no residue after deployment.

A mixture of the liquid chemical suppressants can be used.

Such systems as described with reference to Figures 1 and 2 can have fire suppressant properties similar or equivalent to those which use known total flooding extinguishing agents. They may have applications as an alternative to fixed fire suppression systems using Halons.

CLAIMS

1. A fire or explosion suppression agent, comprising a mist formed from a fire or explosion suppressant which is substantially liquid at normal temperatures and pressures entrained in an inert gas.

2. An agent according to claim 1, in which the substantially liquid suppressant is a chemical suppressant.

3. An agent according to claim 2, in which the chemical suppressant is or includes a hydrofluorocarbon, a bromocarbon, or a halogenated ether.

4. An agent according to any preceding claim, in which the inert gas comprises one or more of argon, nitrogen and carbon dioxide.

5. A method of suppressing a fire or explosion, in which a suppressant which is in liquid form or substantially so at normal temperatures and pressures is discharged into an area to be protected in the form of a mist entrained in an inert gas.

6. A method according to claim 5, in which the substantially liquid suppressant is a chemical suppressant.

7. A method according to claim 6, in which the chemical suppressant is or includes a hydrofluorocarbon, a bromocarbon, or a halogenated ether.

8. A method according to any one of claims 5 to 7, in which the inert gas comprises one or more of argon, nitrogen and carbon dioxide.

9. A method according to any one of claims 5 to 8, in which the mist is produced by physical interaction between the inert gas and the suppressant.

10. A method according to claim 9, in which the physical interaction includes a shearing action.

11. A fire or explosion suppressant system, comprising a source of a suppressant which is in liquid form or substantially so at normal temperatures and pressures, and a source of pressurised inert gas, means for feeding the suppressant and the gas to mixing means to produce a mist of the liquid entrained in the pressurised gas, and discharge means for discharging the so-entrained mist and the pressurised gas into an area to be protected.

12. A system according to claim 11, in which the mixing means comprises means defining a chamber for receiving the suppressant under pressure and the pressurised gas such that they mutually impinge.

13. A system according to claims 11 or 12, in which the discharge means comprises at least one outlet and including narrow pipe means interconnecting the mixing means with the outlet.

14. A system according to any one of claims 11 to 13, in which the substantially liquid suppressant is a chemical suppressant.

15. A system according to claim 14, in which the chemical suppressant is or includes a hydrofluorocarbon, a bromocarbon, or a halogenated ether.

16. A system according to any one of claims 11 to 15, in which the inert gas comprises one or more of argon, nitrogen and carbon dioxide.

17. A fire or explosion suppression agent, substantially as described with reference to the accompanying drawings.

18. A fire or explosion suppression method, substantially as described with reference to Figure 1 of the accompanying drawings.

19. A fire or explosion suppression method, substantially as described with reference to Figure 2 of the accompanying drawings.

20. A fire or explosion suppression system, substantially as described with reference to Figure 1 of the accompanying drawings.

21. A fire or explosion suppression system, substantially as described with reference to Figure 2 of the accompanying drawings.

Application No: GB 0107886.4 **Examiner:** Michael Young
Claims searched: 1-21 **Date of search:** 25 June 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): A5A

Int Cl (Ed.7): A62C 35/02, 39/00

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 95/28204 A1	(SUNDHOLM) whole document relevant	1,4,5,8,9 11,13,16
X	US 5887662	(SUNDHOLM) whole document relevant	1,4,5,8, 9,11,16
X	US 5799735	(SUNDHOLM) whole document relevant	1,4,5,8, 9,11,16
X	WO 99/38573	(SUNDHOLM) whole document relevant	1,4,5,8,9,1 1,13,16

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.